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Extended Summaries SCI Pesticides Group Meeting Semiochemicals in Integrated Crop Management: commercial prospects

The following are extended summaries based on papers presented at the meeting 'Semiochemicals in Integrated Crop Management: commercial prospects', organised by A. J. Mordue on behalf of the SCI Pesticides Group and held on 13 May 1997 at 14/15 Belgrave Square, London. The contents are entirely the responsibility of the authors, and do not necessarily reflect the views of the Editorial Board of Pesticide Science.

Pest Semiochemicals in Arable Crop Protection

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The study of chemical ecology, particularly involving pheromones and other semiochemicals that influence insect behaviour, promises alternative methods of pest control to the exclusive use of broad-spectrum toxicants. However, if the potential of semiochemicals in crop protection is to be realized, a greater understanding of insect/insect/plant interactions and insect chemical ecology generally is essential. Semiochemicals, when employed alone, often give ineffective or insufficiently robust pest control. Use of semiochemicals should therefore be combined with other approaches in integrated management strategies. The main components of such strategies are pest monitoring (to allow accurate timing of treatments), combined use of semiochemicals, host plant resistance and trap crops (to manipulate pest behaviour) and selective insecticides or biological control agents (to reduce pest populations). The objective is to draw together these approaches into a push-pull or stimulo-deterrent diversionary strategy.[1] In a push-pull strategy, the harvestable crop is protected by host-masking agents, repellents, antifeedants or oviposition deterrents. At the same time, aggregative semiochemicals, including host plant attractants and sex pheromones, stimulate colonisation of pests on trap crops or entry into traps where pathogens can be deployed. Because the individual components of the push-pull strategy are not in themselves highly efficient, they do not select for resistance as strongly as conventional toxicant pesticides, thereby making the approach intrinsically more sustainable.

The pea and bean weevil, *Sitona lineatus* L., has provided a model for the initial demonstration of a simple push-pull strategy in UK arable agriculture. In spring, adult males produce an aggregation pheromone which attracts weevils of both sexes into pea and bean crops. Adults feed on young leaves, and larvae cause serious damage to root hairs and nodules. The pheromone, 4-methyl-3,5-heptanedione, which was first identified at IACR-Rothamsted, is used in traps to monitor the migration of weevils from their overwintering sites and to predict their time of arrival in the crop. Such traps should be commercially available in the near future. Experimental field plots were treated either with the pheromone, as the 'pull', or with an antifeedant formulation of neem oil extracted from the neem tree, *Azadirachta indica A.* Juss, as the 'push'. Materials such as neem often do not compare favourably with conventional pesticides in arable agriculture. However, in this trial, the antifeedant was sufficiently active to reduce weevil damage significantly in 'push' plots, while the 'pull' plots, baited with the pheromone, had greater adult and larval damage.[2] This trial demonstrated that *S. lineatus* can be manipulated with semiochemicals, and that control strategies for this and other pests of arable crops could be developed.

Highly successful field results have recently been obtained from a programme aimed at controlling stem

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borers in subsistence cereal cultivation, initially in East Africa, by a push-pull intercropping strategy. The programme involves scientists from the International Centre of Insect Physiology and Ecology, Kenya (ICIPE), and the Kenya Agricultural Research Institute, in collaboration with IACR-Rothamsted and employs field sites near Kitale in northern Kenya and at the ICIPE Mbita Point Field Station on Lake Victoria. The programme is funded by the Gatsby Charitable Foundation as part of its strategy of financing collaborative projects between international research centres in Africa and advanced research centres in the UK.

Two main species of lepidopterous stem borers, one an indigenous Noctuid, *Busseola fusca* (Full.) and the other an introduced species of Pyralid, *Chilo partellus* Swinh., bore at the larval stage into the stems of sorghum and maize, causing complete destruction of the plant or drastic reduction in yield. Six key host plant compounds, including eugenol (4-allyl-2-methoxyphenol), have been identified by electrophysical studies at Rothamsted and shown to be attractive in behavioral studies in Kenya. Repellents from non-host plants, e.g., molasses grass. *Melinis minutiflora* Beauv., have been similarly identified and include α-terpinolene. Following this understanding of volatile components employed by the pests in locating suitable hosts and avoiding non-hosts, a field control programme is being developed involving intercropping of maize and sorghum with other species selected for behavioural activity.

Striking results have been obtained against stem borer colonisation with certain intercropping regimes; for example, when the cereal crop was surrounded by a barrier of Napier grass, *Pennisetum purpureum* Schumach., the adults laid eggs preferentially in the latter. However, the larvae failed to develop to adulthood, although at the same time, normal levels of parasitism were maintained.

With the non-host grass *M. minutiflora* as an intercrop, direct repulsion of the pests occurred, as was also found with a *Desmodium* species of nitrogen-fixing legume. In each case, the intercrop can be used as cattle feed, although a 'training period' may be necessary for the new forage to be acceptable to cattle. This strategy fits in well with small or medium-sized farms, i.e., up to 50 ha, which have an appropriate mix of cereal and cattle production or are in communities where trade in a surplus of either crop type can easily be managed. In addition to the direct reduction of stem borers through some of the intercropping programmes, improvements in parasitism have been observed with the intercrop of *M. minutiflora*.[3] The trap crop, *P. purpureum*, also acts as a windbreak, preventing lodging of maize.

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Semiochemicals to Increase Parasitism in Aphid Pest Control

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Parasitic wasps or parasitoids are important biological control agents which have been used extensively in biological control and integrated pest management schemes in agriculture in many parts of the world. Some parasitoids are specific natural enemies of aphids and several species of these are produced commercially for use against aphid pests, principally on protected crops. A number of European species have been introduced into other regions of the world to help to control aphids on arable crops such as legumes and cereals. Aphid parasitoids have considerable potential as biological control agents but their efficiency is dependent upon their presence in the right place at the right time; their appearance in crops should be synchronized with colonising pest populations early in the season. Our understanding of parasitoid behaviour, particularly their responses to semiochemical cues during the host location and host recognition phases of the foraging process, is providing exciting opportunities for the manipulation of parasitoids in the field to enhance their impact on pest populations.[1] However, to develop realistic pest control strategies involving manipulation with

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